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Austro-American lignocellulolytic basidiomycetes (*Agaricomycotina*): new records

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Abstract — A survey of lignolytic basidiomycetes from Mondaí (27°06'16"S, 53°24'07"W) in the Brazilian state of Santa Catarina has revealed nine previously unrecorded species: *Dacryopinax elegans*, *Cotylidia aurantiaca, Hymenochaete rubiginosa*, *Inonotus rickii, Phellinus rhytiphloeus*, *Echinoporia aculeifera*, *Oxyporus obducens*, *Amauroderma sprucei,* and *Pseudofavolus miquelii*. Comments about the species and illustrations are provided.

Key words — mycodiversity, *Agaricomycetes, Dacrymycetes*

Introduction

Among the estimated 1.5 million fungal species, only 74,000 to 120,000 species have been described. With limited human and financial resources, a total inventory is not possible within any reasonable time frame, which is estimated to be 1290 years at the current rate (Garibay-Orijel et al. 2009). Within the field of mycology, there are numerous studies about the diversity of macrofungi. However, Gilbert & Souza (2002) and Piepenbring (2007) point out that a significant portion of the fungal taxa from tropical forests has not yet been described.

In the southern region of coastal South America, the Atlantic Forest is broadly defined and includes not only coastal rain forests but also inland forests and coastal seasonal forests, which are mostly semi-deciduous and mixed *Araucaria* forests (Fernandes & Bezerra 1990).

Knowledge about the abundance of lignolytic basidiomycetes in all forest types, as well as the fact that they are the largely responsible for decaying wood in most ecosystems, is well established. However, fundamental questions, such as how many species are from a specific region or whether fungal diversity is greater in one forest type versus another, remain unanswered due to taxonomic

issues and the deficiency of long-term studies in many regions (Groposo et al. 2005). There is a common belief that some wood-decaying basidiomycetes generally have low host- and habitat-specificity, and this assumption somewhat complicates evaluation of the ecological specialization and species distribution based on past studies (Gilbert et al. 2008).

Regardless of its biological richness, the Atlantic Forest is probably one of the most highly threatened tropical forests in the world (Jarenkow & Budke 2009). In the past, commercial exploitation of this area has led to deforestation. Currently the Atlantic forest is extremely fragmented and many endemic species are endangered (Metzger 2009).

In the state of Santa Catarina, several studies have been published that include data about collections from the Atlantic Forest of Santa Catarina Island. However, in other areas of the state little is known about their mycodiversity. The work presented here — a result of the first extensive survey carried out in the deciduous seasonal forest of Santa Catarina — aims to expand the knowledge about the region's mycodiversity. It is also part of a current taxonomic and biogeographical survey of wood-inhabiting basidiomycetes in this state. Additional collections made during this survey from the municipality of Mondaí (from deciduous seasonal forest) resulted in several previously unrecorded species of *Agaricomycotina*, which are briefly discussed below.

Material and methods

The municipality of Mondaí is located in the extreme western part of the state of Santa Catarina (27º06'16"S, 53º24'07"W), in Southern Brazil. Collections were made periodically between December 2005 and May 2007 at two locations (Linha Uruguai and Linha Sanga Forte) in Mondaí.

Macro- and microscopic data of the specimens were collected following traditional methodology (Singer 1975, Ryvarden 1991). Measurements were made from slide preparations stained with 1% phloxine solution + 1% or 5% KOH solution. Melzer's reagent was used to detect the presence of amyloid or dextrinoid reactions on the cell walls. Collections were identified by consulting literature and specimens in the following herbaria: BAFC, FLOR, ICN, NYBG, SP, URM (Holmgren & Holmgren 2009). Voucher specimens are stored at FLOR. Taxonomic arrangement follows Kirk et al. (2008).

Taxonomy

Dacryopinax elegans (Berk. & M.A. Curtis) G.W. Martin, Lloydia 11(2): 116. 1948. Fig. 1

≡ *Guepinia elegans* Berk. & M.A. Curtis, Hook. J. Bot. Kew Gdn Misc. 1: 239. 1849.

Description: McNabb (1965).

Voucher material: BRAZIL. Santa Catarina: Mondaí, Linha Sanga Forte, Campos-Santana & Santana 302, 25/V/07 (FLOR 32214).

Fig. 1. *Dacryopinax elegans*. Scale =10 μm.
A. Septate hairs. B. Generative hyphae. C. Dendrohyphidium. D. Hymenium. E. Basidiospores.

Comments: The species is recognized by its stipitate basidiomata, solitary or in groups; pileus spathulate, flabelliform, initially cupulate or obliquely cupulate;

consistency gelatinous or cartilaginous. Microscopically it is characterized by the presence of a cortex, medulla, and hymenium; cortex and stipe present cylindrical, tortuous, thin or thick walled, tinted brown septate hairs. The cylindrical-subclavate basidia with basal septa, become bifurcate and the basidiospores are cylindrical, thick-walled with thick septa, yellowish brown, apiculate, becoming 3-septate at maturity are characteristic. As noted by McNabb (1965), *D. elegans* is distinguished as the only *Dacryopinax* species with thick-walled hyphae and tri-septate basidiospores. In our collection, the basidiospores (12–14(–15) × 5–6(–6.5) μm) are similar to those observed by McNabb (1965; (12–)14–15.5 × 5–6.5 μm) and Fonseca et al. (2002; 13.6–15.6(–16) × 5.6–6.4 μm). However, López & Garcia (2001) cite slightly larger basidiospores ((13–)14–16(–19) × 5.6–6.04 μm).

Additional material: ARGENTINA, Bs. As., Llava llol, Sta. Cat. Inst. Fitotéc., R.T.Guerrero, 18/IV/1963 (BAFC 23086); ibid, Sgo. del Estero, Depto Choya, el Salvador, R.E.dela Sota (Det. R.T. Guerrero), 20/V/1961 (BAFC 23097).

Distribution: Brazil (Espírito Santo, Amazonas, Rio Grande do Sul, Rio de Janeiro, Roraima), Colombia, Costa Rica, Dominican Republic, Guiana, Jamaica, Mexico, Panama, Puerto Rico, Trinidad & Tobago, Venezuela (McNabb 1965, Fonseca et al. 2002, Roberts 1996, Sobestiansky 2005).

Cotylidia aurantiaca (Pers.) A.L. Welden, Lloydia 21: 40, 1958. Fig. 2

≡ *Thelephora aurantiaca* Pers., Voy. Uranie, Bot. 5: 176, 1827.

Description: Reid (1965)

Voucher material: BRAZIL, Santa Catarina: Mondaí, Linha Uruguai, Campos-Santana & Santana 205, 23/V/2007 (FLOR 32308); ibid, Linha Sanga Forte, Campos-Santana & Santana 262, 25/V/2007 (FLOR 32309).

Comments: *Cotylidia aurantiaca,* which is one of the most common species collected in the tropical America (Reid 1965), exhibits a wide morphological variation, commonly spathulate, ligulate, flabellate or reniform, pseudo-infundibuliform or infundibuliform. This species is characterized by a bright yellow fresh hymenial surface that discolors to creamy-ochre when dry, basidiospores that are thin-walled, hyaline, elliptical, a monomitic hyphal system, and variably shaped cystidia, some of which develop 1–3 transverse septa and frequently constrict somewhat at these points. In our collection, the basidiospores (6–9 × (2.5–)4.5(–5) μm) are similar to those observed by Reid (1965; (5.5–)6–8.75(–9) × 3–3.75(–4) μm) and in one collection from Argentina (BAFC 24989: 7–9 × 2.5–4 μm).

Additional material: ARGENTINA, Misiones, Colônia Belgrano, monte al SE próximo de la Estación Forestal, Wright, Deschamps & Del Busto, M-2455, 29/X/1973 (BAFC 24989).

Distribution: Brazil (Rio de Janeiro, Amazonas, Rio Grande do Sul), Argentina, Costa Rica, Colombia, China, Equador, Paraguay, Santo Domingo, Trinidad (Dai et al. 2004, Reid 1965).

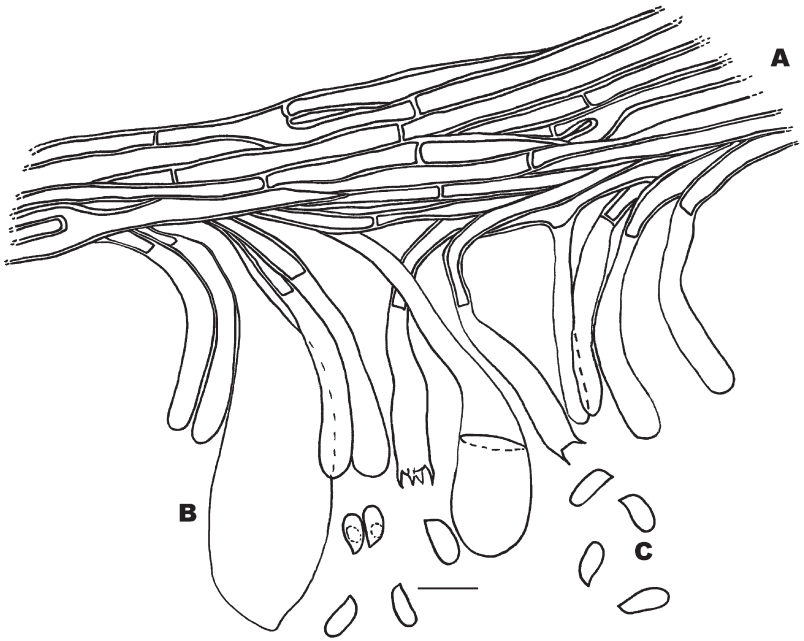

Fig. 2. *Cotylidia aurantiaca* hymenium. Scale =10 μm.
A. Generative hyphae. B. Cystidia. C. Basidiospores.

Hymenochaete rubiginosa (Dicks.) Lév., Ann. Sci. Nat. Bot., 3e Sér., 5: 151, 1846. Fig. 3

≡ *Helvella rubiginosa* Dicks. Fasc. Pl. Crypt. Brit.1: 20, 1785.

Description: Job (1985)

Voucher material: BRAZIL, Santa Catarina: Mondaí, Linha Sanga Forte, Campos-Santana, Santana & Rodrigues-Souza 10, 03/I/06 (FLOR 32215).

Comments: The examined material is typical for this species. Basidiospore measurements (3–6 × 2–2.5 μm) were close to those recorded by Parmasto (2001; (3.5–)3.8–5.5 × (1.8–)2–2.8(–3) μm), and slightly smaller than those reported by Cunningham (1956; 5.5–7 × 3.5–4 μm). This species is easily recognized in the field by its rigid reflexed margin, dark brown upper surface, and light yellowish brown to yellow hymenophore. Chamuris (1988) and Cunningham (1956) point out that these features distinguish *H. rubiginosa* from *H. tabacina* (Sowerby) Lév., which has a reflex flexible region, orange-brown upper surface, and pale hymenophore. Job (1985) observed that *H. rubiginosa* is one of the few species of the genus with a cosmopolitan distribution.

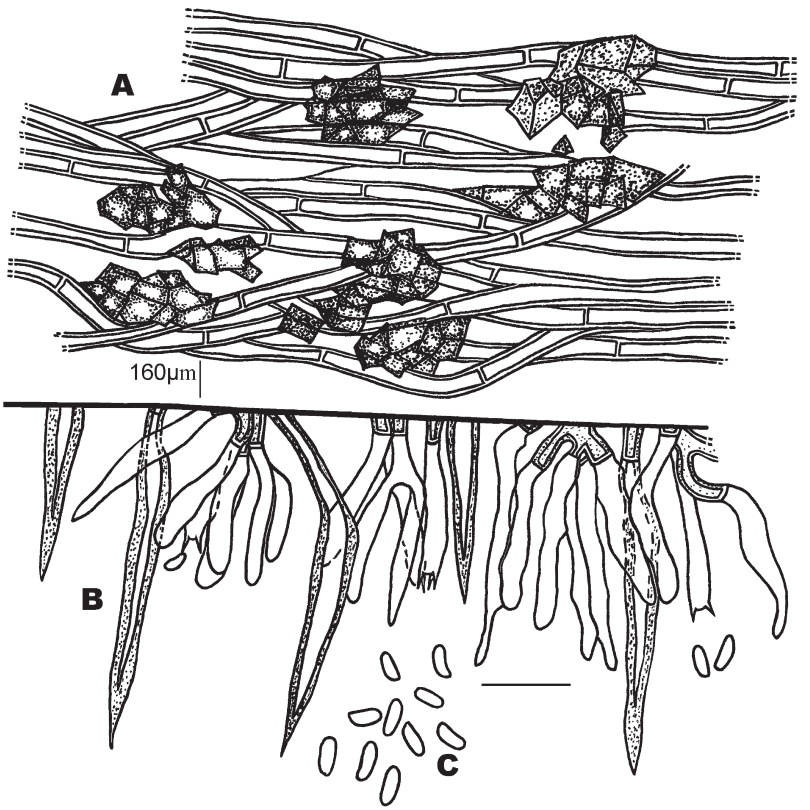

Fig. 3. *Hymenochaete rubiginosa*. Scale =10 µm.
A. Context generative hyphae. B. Setae. C. Basidiospores.

Additional material: BRAZIL, São Paulo: Santo André, Reserva Biológica do Alto da Serra de Paranapiacaba, Trufem SB & Grandi RAP, 09/VIII/88 (SP 307428).

Distribution: Cosmopolitan; Brazil (Rio Grande do Sul and São Paulo), Europe, North America, New Zealand, Norway, Central America and Argentina (Cunningham 1963, Fonsêca 1999, Job 1985, Reeves & Welden 1967, Ryvarden 1971).

Inonotus rickii (Pat.) D.A. Reid, Kew Bull. 12: 141, 1957. Fig. 4

≡ *Xanthochrous rickii* Pat., Bull. Soc. Mycol. France 24(1): 6, 1908.

Description: Ryvarden (2005).

Voucher material: BRAZIL, Santa Catarina: Mondaí, Linha Sanga Forte, Campos-Santana & Santana 288, 25/V/07 (FLOR 32216).

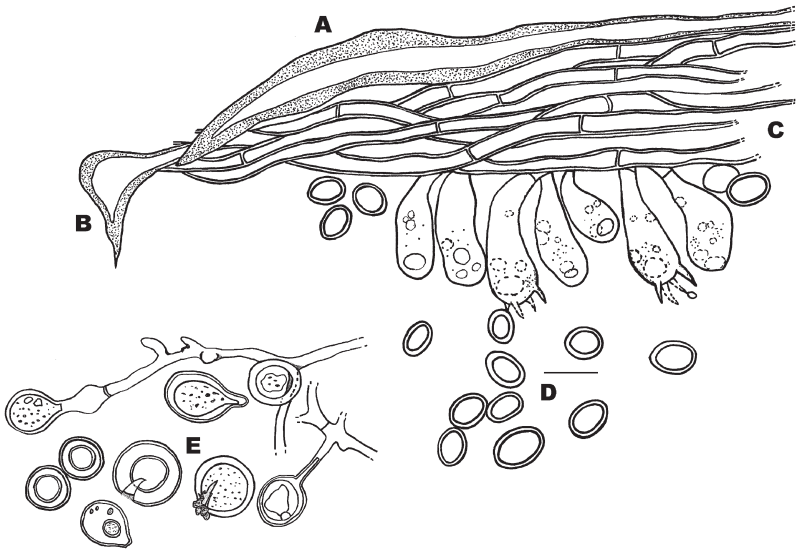

Fig. 4. *Inonotus rickii.* Scale =10 μm.
A. Setal hyphae. B. Hymenial setae. C. Generative hyphae.
D. Basidiospores. E. Chlamydospores.

Comments: Some authors, such as Coelho (1994), Melo et al. (2002), and Ryvarden (2005) described setal hyphae that ranged from 250 × 17.94 μm. Although these measurements are similar to those in the Mondaí specimens, the longer hyphal setae found in the context — 400(–500) × 9–20(–22) μm) — agrees with the sizes cited reported by Intini & Tello (2003). Basidiospore size in our specimens (6–8 × 4–7 μm) is similar to that reported by Coelho (1994; 6.55–8.95 × 5.7–6.2 μm) but larger than those reported by Melo et al. (2002) and Gilbertson & Ryvarden (1986; 6–8.5(–9) × 4.5–5.5 μm). Abundant chlamydospores (8–18 × 8–17 μm) were found in the context, as observed by Melo et al. (2002).

Additional material: BRAZIL, Rio Grande do Sul: Porto Alegre, Ponta Grossa, Eny C.Vianna, IV/93 (ICN 97681); ibid, Parque da Redenção, R.T. Guerrero, I/90 (ICN 97594); ibid, Santa Maria, Itaara, Parque Pinhal, G. Coelho 24-13, 07/VI/1992 (ICN 97677); ibid, Caturrita, S. Aldorindo, G. Coelho 20-06, 1992 (ICN 97676).

Distribution: Pantropical—North America, Central America, South America (Brazil in Rio Grande do Sul, Argentina), (Coelho 1994, Robledo & Rajchenberg 2007).

Phellinus rhytiphloeus (Mont.) Ryvarden, Prelim. Polyp. Fl. E. Africa: 206, 1980. FIG. 5

≡ *Polyporus rhytiphloeus* Mont., Ann. Sci. Nat., Bot., 4e Sér., 5: 369, 1857.

DESCRIPTION: Ryvarden & Johansen (1980).

VOUCHER MATERIAL: BRAZIL, Santa Catarina: Mondaí, Linha Uruguai, Campos-Santana, Santana & Zanella 77, 15/VI/2006 (FLOR 32218); ibid, Campos-Santana & Santana 257, 290, 25/V/07 (FLOR 32219, FLOR 32220).

COMMENTS: Our specimens show 7–9 pores per mm and basidiospores measuring 4–5(–5.5) µm in diameter, as previously reported by Ryvarden & Johansen (1980). Globose, golden to rusty brown basidiospores and absence of setae are characteristic. As observed by Gibertoni (2004), basidiospore size and color and basdioma morphology distinguish *P. rhytiphloeus* from the other *Phellinus* species that lack setae. In their original description, Ryvarden & Johansen (1980) noted that the absence of setae differentiates *P. rhytiphloeus*

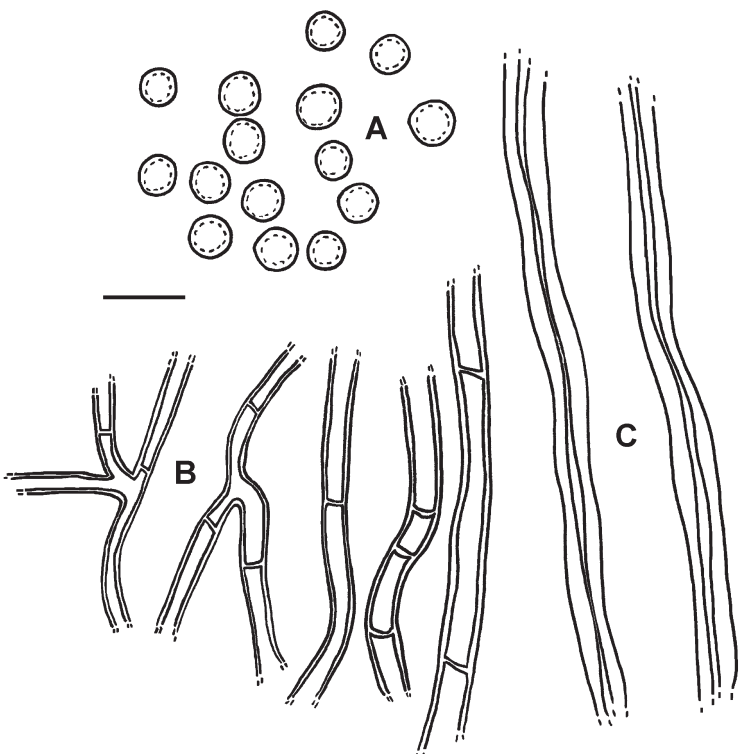

FIG. 5. *Phellinus rhytiphloeus*. Scale =10 µm.
A. Basidiospores. B. Generative hyphae. C. Skeletal hyphae.

from *Phellinus rhabarbarinus* (Berk.) G. Cunn. (Gerber & Loguercio-Leite 1997). Our examinations of *P. rhabarbarinus* specimens (FLOR 10.922; FLOR 10.929) confirm this and also show that the size (3–4 × 2–2.5 µm) of the hyaline ellipsoid basidiospores is another character that differentiates these species.

Additional material: BRAZIL, Rio Grande do Norte: Baía Formosa, RPPN Senador Antônio Faria-Mata Estrela, Gibertoni, V/20002 (URM 77794); ibid, Santa Catarina: Florianópolis, Morro da Lagoa da Conceição, Furlani & Loguercio-Leite, 186, 26/XII/1988 (FLOR 10929); ibid, Gerber & Cabral, 318, 12/XI/1993 (FLOR 10922); ibid, Willerding, A. & Santos, B., 420, 02/IV/94 (FLOR 10920); ibid, Santo Amaro da Imperatriz, Atanazio, J. & Willerding, A., 450, 20/V/1994 (FLOR 10928); ibid, Palhoça, Parque Estadual Serra do Tabuleiro-Cambirela, Groposo & Andrade, 176, 18/VII/2001 (FLOR 11957).

Distribution: Neotropical; Brazil (Rio Grande do Norte), Jamaica, Surinam, Mexico and Venezuela (Gibertoni & Cavalcanti 2003, Ryvarden & Guzmán 1993, Ryvarden & Iturriaga 2001).

Echinoporia aculeifera (Berk. & M.A. Curtis) Ryvarden, Mycotaxon 20(2): 330, 1984. Fig. 6

≡ *Trametes aculeifera* Berk. & M.A. Curtis, J. Linn. Soc., Bot. 10: 319, 1868.

Description: Silveira & Guerrero (1991).

Voucher material: BRAZIL, Santa Catarina: Mondaí, Linha Uruguai, Campos-Santana & Santana 244, 23/V/07 (FLOR 32222).

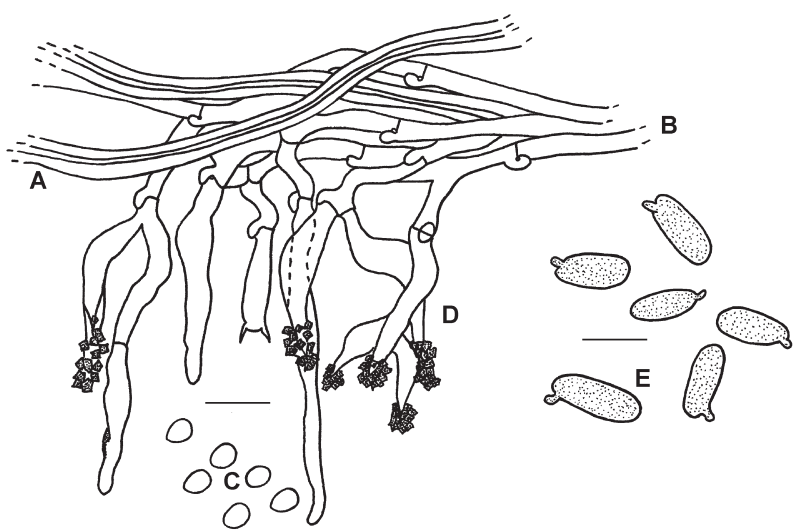

Fig. 6. *Echinoporia aculeifera*. Scale =10 µm.
A. Skeletal hyphae. B. Generative hyphae. C. Basidiospores.
D. Cystidia. E. Conidiospores.

Comments: The species is easily recognized in the field by the dense cover of long yellowish-orange to red hairs (hydnoid processes) and irregular pores. *Echinoporia aculeifera* produces abundant conidiospores, absent in other polypores, as pointed out by Gilbertson & Ryvarden (1986). Wright (1983) reported rare cystidia with a crystal crown (11.3–21.7 × 4.1–5.2 µm). Our collection had abundant cystidia and incrusted hyphal terminations. The basidiospore size (5–7 × 3–4 µm) agrees with that cited by Silveira & Guerrero (1991). However, Gilbertson & Ryvarden (1986) noted smaller basidiospores (4–5 × 3–3.5 µm).

Additional material: ARGENTINA, Misiones, Cataratas del Iguazú, Singer & Digilio, M-132, 27/XI/49 (BAFC 27280); ibid, Parque Nacional Iguazú, plaza cerca Salto Dos Hermanos, J.E. Wright, M-3028, 28/IX/79 (BAFC 24462).

Distribution: Neotropical; Brazil (Bahia, Rio Grande do Sul Paraná and São Paulo), North American, Central America and South America (Fonsêca 1999, Gilbertson & Ryvarden 1986, Góes-Neto 1999, Popoff & Wright 1998, Rajchenberg & Meijer 1990, Silveira & Guerrero 1991).

Oxyporus obducens (Pers.) Donk, Med. Bot. Mus. Univ. Utrecht 9: 202, 1933. Fig. 7
≡ *Polyporus obducens* Pers., Mycol. Eur. 2: 104, 1825.

Description: Núñez & Ryvarden (2001).

Voucher material: BRAZIL, Santa Catarina: Mondaí, Linha Uruguai, Campos-Santana & Santana 213, 23/V/07 (FLOR 32223).

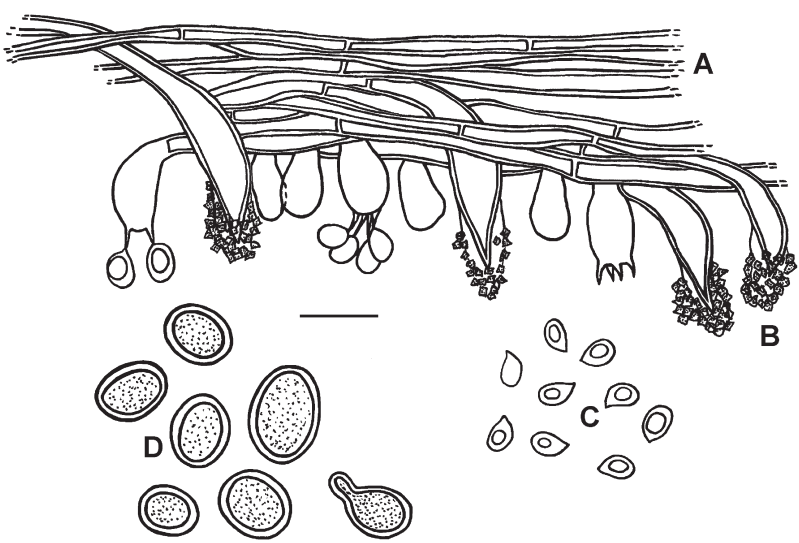

Fig. 7. *Oxyporus obducens*. Scale =10 µm.
A. Generative hyphae. B. Cystidia. C. Basidiospores. D. Chlamydospores.

Comments: The specimen studied differs from other resupinate *Oxyporus* species by the number of pores (4–6 per mm), basidiospore size (3–5(–6) × 3–4 μm), and the presence of chlamydospores. There are few discrepancies between our observations and the literature. Our collection agrees with Núñez & Ryvarden (2001), who recorded similarly sized cystidia (25–55 × 7–8 μm) and basidiospores (4–5 × 2.5–3.0 μm). Ryvarden & Gilbertson (1994) reported slightly smaller basidiospores (3–4.5 × 2.5–3.5 μm) and cystidia (15–30 × 5–12 μm).

Additional material: BRAZIL, Santa Catarina: Santo Amaro da Imperatriz, Morro das Três Voltas, Michels, Esber, Groposo & Marcon-Baltazar 496, 20/III/2005 (FLOR 31806); ibid: Florianópolis, Ratones, Loguercio-Leite & Furlani 383, 27/I/1989 (FLOR 10702).

Distribution: Cosmopolitan; Brazil [Rio Grande do Sul], Argentina, China, Czechoslovakia, Finland, Japan, Russia, USA, Venezuela (Núñez & Ryvarden 2001, Dai et al. 2004, Ryvarden & Gilbertson 1994, Robledo et al. 2006, Ryvarden & Iturriaga 2001, Rick 1960).

Amauroderma sprucei (Pat.) Torrend, Brotéria Bot. 18: 121, 1920. Fig. 8

≡ *Ganoderma sprucei* Pat., Bull. Soc. Mycol. France 10: 75, 1894.

Description: Decock & Herrera Figueroa (2006).

Voucher material: BRAZIL, Santa Catarina: Mondaí, Linha Uruguai, Campos-Santana, Santana & Rodrigues-Souza 190, 27/XII/06 (FLOR 32210).

Comments: The globose to subglobose basidiospores (9–10 × 7–8 μm) of our collection are similar in size to those (8.5–10 × 7–9 μm, 9–10 × 7–8 μm) seen in the additional material (URM 77450; URM 77451) as well as those reported by Ryvarden (2004) and Furtado (1981; 8–10 μm, (6–)8–10 μm in diam]. Decock & Herrera Figueroa (2006) observed basidiospores measuring (6.5–)7.5–9.8 (–10.3) × (6.5–)7–9(–9.5) μm. Although Ryvarden (2004) describes *A. sprucei* as producing globose basidiospores, the Mondaí material (FLOR32210), URM 77450, and URM 77451 showed globose to subglobose basidiospores, matching the shape reported by Decock & Herrera Figueroa (2006). *Amauroderma sprucei* differs from other *Amauroderma* species known from Santa Catarina — *A. schomburgkii* (Mont. & Berk.) Torrend, *A. omphalodes* (Berk.) Torrend, *A. intermedium* (Bres. & Pat.) Torrend, *A. brasiliense* (Singer) Ryvarden, *A. camerarium* (Berk.) J.S. Furtado — by its reddish yellow hymenophore and dextrinoid skeletal hyphae.

Additional material: BRAZIL, Sergipe: Itabaiana, Estação Ecológica Serra de Itabaiana, Gibertoni 44616, III/2002 (URM 77450); ibid, Gibertoni 44617, III/2002 (URM 77451); ibid, Santa Catarina: Santo Amaro da Imperatriz, Hotel Caldas da Imperatriz, Larissa T. Pereira, 31/III/2007 (FLOR 32197); ibid, Vargem Braço — PEST, Groposo 110, 28/III/2001 (FLOR 31323); ibid, Trilha da Cascata — PEST, Groposo 097, 05/I/2001 (FLOR 11902); ibid, Florianópolis, Rio Tavares, Furlani 274, 04/VII/1986 (FLOR 10460); ibid, Ilhota — Morro do Baú, Groposo, VII/2003 (FLOR 31344).

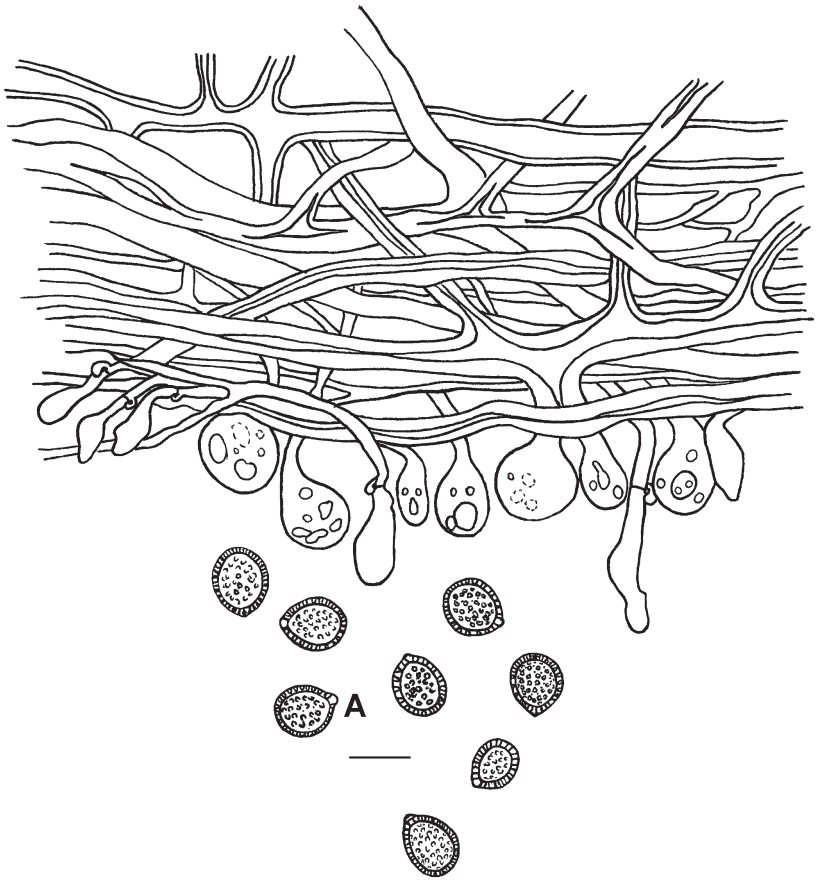

Fig. 8. *Amauroderma spruce* hymenium. Scale =10 µm.
A. Basidiospores.

Distribution: Neotropical; Brazil (Amazonas, Rio Grande do Sul, Minas Gerais, Mato Grosso, Pernambuco, Rio de Janeiro, São Paulo, Paraná and Sergipe), Costa Rica, Cuba, Belize, French Guyana and Venezuela (Torrend 1920, Rick 1938, Furtado 1981, Ryvarden & Meijer 2002, Gibertoni 2004, Corner 1983, Ryvarden 2004, Decock & Herrera Figueroa 2006).

Pseudofavolus miquelii (Mont.) Pat., Essai Tax. Hymenomyc.: 81, 1900. Fig. 9
≡ *Polyporus miquelii* Mont., Ann. Sci. Nat., Bot., 3e Sér., 4:357, 1845.

Description: Ryvarden & Johansen (1980).

Voucher material: BRAZIL, Santa Catarina: Mondaí, Linha Sanga Forte, Campos-Santana, Santana & Zanella 109, 16/VI/06 (FLOR 32225).

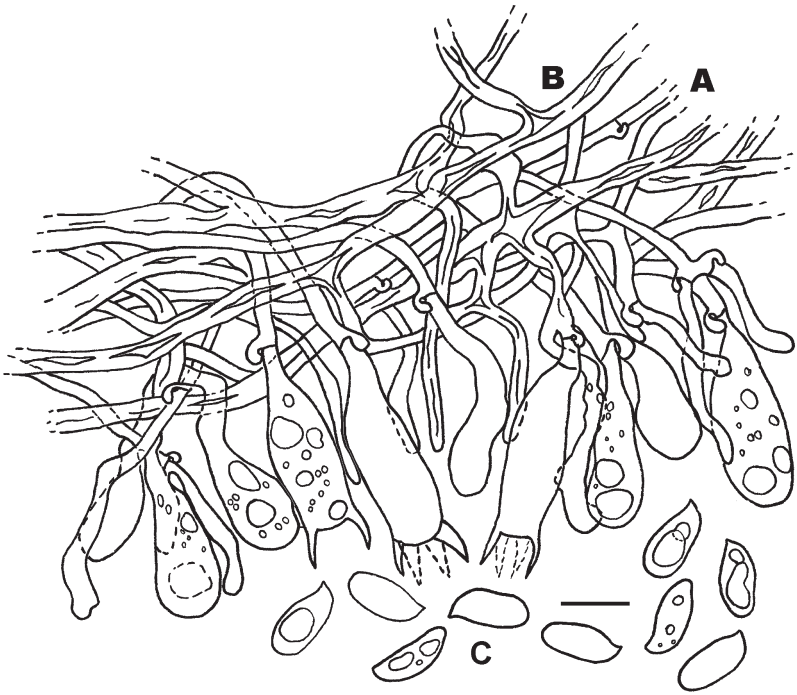

Fig. 9. *Pseudofavolus miquelii*. Scale =10 μm.
A. Generative hyphae. B. Skeleto-binding hyphae. C. Basidiospores.

Comments: Núñez & Ryvarden (1995) characterized *P. miquelii* as having a very thin context, large and angular pores, and basidiospores greater than 15 μm long. Our basidiospores (10–16 × 4–6 μm) are very similar to material from Costa Rica (NYBG 00354169, NYBG 00354168: 10–17 × 5–7 μm) and slightly smaller than those recorded by Ryvarden & Johansen (1980; (14.5–)16–20 × 6.5–8.0 μm) and Corner (1984; 12–18 × 6–8.5 μm). Ryvarden & Johansen (1980) pointed out that the absence of a cuticle, the very thick context (1–2 mm), and number of the pores per mm ((1–)2–3) separate this species from *Pseudofavolus cucullatus* (Mont.) Pat. Corner (1984) considered *P. cucullatus* a variety of *Polyporus miquelii*.

Additional material: COSTA RICA, El Jardin, Dota, L. Echeverria 41-78, 21/III/1900 (NYBG 00354169); ibid, SJ Montana, L. Echeverria 65-78, /1900 (NYBG 00354168); BRAZIL, Santa Catarina: Santo Amaro da Imperatriz, Morro das Três Voltas, Michels, Esber, Groposo e Marcon-Baltazar 494, 20/III/2005 (FLOR 31805); ibid, Ilha de Santa Catarina, Rio Vermelho, Loguercio-Leite, 14/XII/1984 (FLOR 10104); ibid, Paraná, Capanema, Basso, 27/XII/1996 (FLOR 11500).

Distribution: Pantropical; Brazil (Mato Grosso do Sul), Australia, Africa, Paraguay and Costa Rica (Ryvarden & Johansen 1980, Núñez & Ryvarden 1995, Popoff & Wright 1998, Velázquez & Ruíz-Boyer 2005).

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